From Assembly Line to Industry 4.0: The Evolution of Manufacturing

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Abstract

Beginning with the development of the assembly line by Mr. Henry Ford, the industrial sector has seen a considerable shift since the late 18th century. The industry has continually changed to be more effective, efficient, and increase productivity, beginning with the mass production of standardized items in the 20th century and ending with the talk about automation and robots in 2017. The industrial 4th revolution will combine cutting-edge technology like artificial intelligence, machine learning, smart factories, big data analytics, and the internet of things to create a more effective and connected environment. This paper will discuss the turning points, trends and patterns, and problems in the development of manufacturing starting from the assembly line to Industry 4.0. In its later part, the paper will discuss the potential pros that the latest Industry offers, that include customization by the customers, sustainability, and protection of employees. Moreover, it discusses the essential methods for businesses to adopt and succeed. Ultimately, the paper will conclude that Industry 4.0 represents a transformative shift in the manufacturing sector that will revolutionize the way humans conceive, fabricate, and utilize various products.

Introduction

The beginning of the Industrial Revolution was in the 18th century. The first discovery was steam power followed by electricity and assembly line production methods. Then, in the 19th century came automation in production methods and finally the use of the Internet which brought a boom in production volume and a reduction in human intervention. All smart factories use the latest Industry 4.0 and 5.0 components for their efficient day-to-day work. Manufacturing became digitalized as goods are now being produced, supervised, and distributed with help of the supply chain, data analytics, and the Internet. It is based on the high-speed network connection, machine learning, and artificial intelligence. It helps in the

efficient and effective working of all the firms. It is bringing a new revolution in how businesses of manufacturing, automobile, and others are working.

Industrial Revolution

1.1 Industry 1.0: Industry is transforming for decades with the usage of the power of steam and production through machines being the first revolution in industries. It is usually known as Industry 1.0 which kicked off in the 18th century. The spinning wheels were converted into machines that produced more than 8 times the previous volume. (Lenzen & Murray, 2001)

As steam power was already in use but its extended use in industrial activities boosted human productivity. Along with human power, when steam power was combined, production skyrocketed. The second-best invention with help of steam power is the steam-powered locomotive. They usually helped to deliver raw materials, goods, and other commodities within a few hours. (Mathias, 2013)

1.2 Industry 2.0: This industrial revolution also began in the 19th century with the invention of electricity along with production through the assembly line. Assembly line is a process by which production is done by breaking the manufacture of a good into different steps and at last they are assembled. (Cook, 2008) This process is used in the mass production of any commodity. It is famous in the automobile industry. Currently, with help of this process, vehicles are manufactured in various steps which are significantly fast and is of lower cost than manufacturing vehicle as a whole. (McAfee, 2009)

1.3 Industry 3.0: This revolution began in the late 19th and early 20th centuries. It came with partial automation of vehicles with help of controls that are memory programmed and also with the use of computers in production. (Padró & Stanilovsky, 2012)

Now, with the discovery of former technologies, different processes of production can be machine-driven without the assistance of humans. As proof, nowadays robots are working without the help of humans. (Brown, 2008)

1.4 Industry 4.0: The Fourth Industrial Revolution is currently in use. It includes the use of information and communication technology in industries. It is based on the advancements

in the Third Industrial Revolution. Production systems that were using computer technology are enhanced by high-speed network connectivity. It is popularly known as the Internet. Internet facilitates communication with other systems as well as the production of data of themselves. (Lasi et al., 2014) This is the next phase in machine-driven production of various consumer and industry goods.

All systems are connected with each other, resulting in cyber production systems. As a result, smart factories use this technology and production systems, employees and managers communicate via the internet, and the production activities taking place in these factories is almost automatic. (Lu, 2017)

1.5 Industry 5.0: The fifth revolution in industries mainly consists of working with humans with more than half the work done by robots and automatic machines. (*Industry 5.0: Industrial Revolution With a Soul*, n.d.) It being started in early 2017 and now being adopted all around the world. It is an advancement in Industry 5.0 such as the addition of efficiency, effectiveness, and automation to previous technology.

The main focus of advancement in technology is changed as the previous focus was profitability and more volume in production but the current focus is achieving societal goals, sustainability, and consumer satisfaction. (Mathias, 2013)

1.6 Industry 6.0: The sixth and the current latest industrial revolution will soon be implemented in the next 15 years or so. It is projected to be completed in 2050. It focuses on the service-providing sector and each and everything will be virtually controlled and managed. This industrial revolution will be customer-driven.

Statement of problem

The latest industrial revolution and the previous one's adoption are very slow in developing and under-developed countries of the world. In this, we will take example of country – India and discuss the problems faced by the companies while introducing new methods of production in their manufacturing unit. The key challenges faced are as follows: (Abdoh et al., 2017)

Table 1:

Challenges	Example of challenges
POLITICAL	Stability of the government in India.
ECONOMIC	Interest and inflation rates increment in the country, cost of high-speed internet services, allocation of GDP and so on
SOCIAL	Intellect level of employees and management in adoption of new techniques of Industry 4.0 in their manufacturing units, and IT skills
TECHNOLOGICAL	Availability of latest machinery, infrastructure, technology, internet connectivity of high-speed
ENVIRONMENTAL	Type of technology – is it eco-friendly or not?
LEGAL	What are the laws of constitution related to privacy and security, is there any particular framework?

Objectives of study

- To identify the most relevant problem faced by the companies?
- To identify if the problem can be solved at company level or not?

Data Analysis

In this, the data has been collected in which various firm owners identifies which is the main problem faced by them during the adoption of new technology in their manufacturing plant. The total number of participants were 30 from various parts of the India.

Table 2:

Challenges	Very Common	Common	Neutral	Not common	Very rare	SD	Skewness	Kurtosis
POLITICAL	5	7	10	5	3	2.367	0.809	0.673
ECONOMIC	10	8	5	4	3	2.607	0.605	-1.598
SOCIAL	12	8	2	3	5	3.63	0.82	-0.424
TECHNOLOGICAL	18	9	2	1	0	6.78	1.29	0.693
ENVIRONMENTAL	7	5	2	4	12	3.405	1.08	1.334
LEGAL	11	8	3	5	3	3.098	0.781	-1.02

According to the data collected and its analysis, technological problems are the challenges which are faced by almost all the companies (90%). The standard deviation of technological problems is very high because the curve is left facing as the greatest number of participants face these problems very often.

The skewness of participants facing technological issues is very high.

Table 3:

Rate	**Technology issues**
Very Common	18

Common	9
Neutral	2
Not common	1
Very rare	0

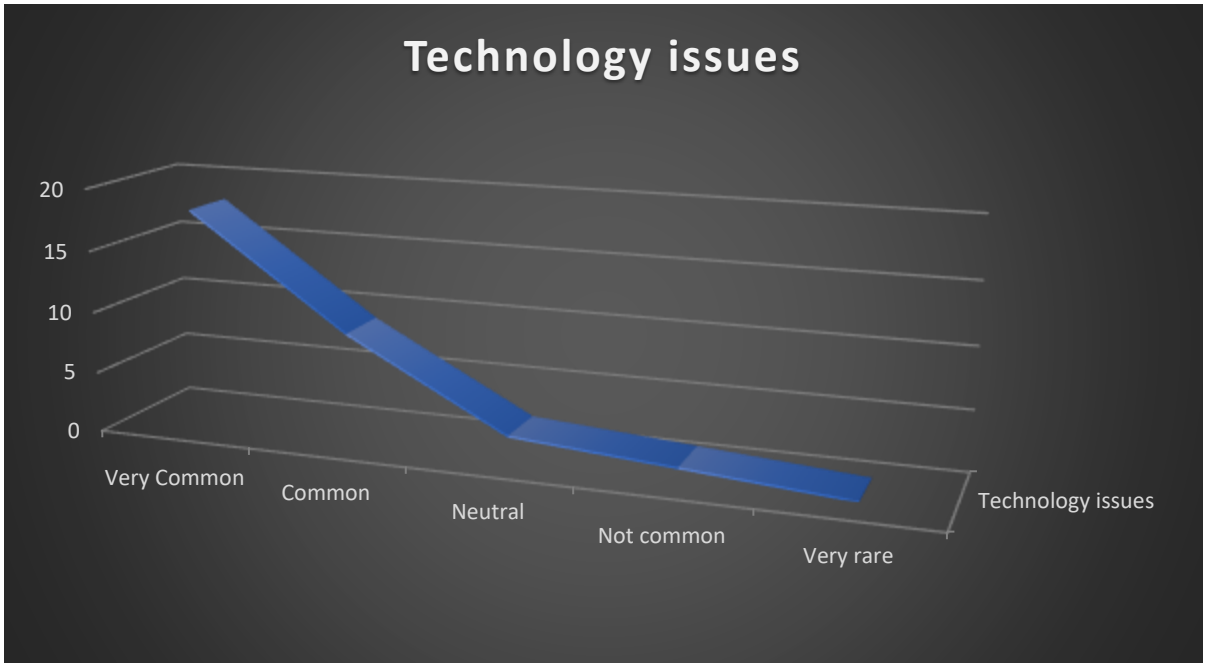

Fig:1 Technology Issues

How to solve technological problems?

Finding efficient and effective solutions is crucial to enable the successful adoption of these technologies. The problems that might develop while deploying Industry 5.0 and 4.0 technologies can vary from cybersecurity or privacy problems to hardware and software integration in database.

Collaboration and communication among stakeholders is the main and primary strategy for solving technical issues in the Industry. The people involved are engineers, IT employees, production staff, and management groups. Companies are able to recognise and handle technological issues when they see diverse viewpoints and various areas of expertise. The implementation of Industry techniques is more effective for businesses that has always given a

high priority to cooperation and communication, according to research from Ernst & Young (Ernst & Young, 2016).

The government of the country should invest or give a part of budget to help small factory owner in implementation of smart factory techniques which will increase the production as well as the profit for the firm and GDP for the country.

Conclusion

Industry 4.0 has transformed how production, data collection, and delivery of data were conducted. Smart factories are using this technology and production systems, employees and managers communicate with help of the internet, and with help of machine learning and artificial intelligence, the production activities taking place in these factories are almost automatic.

According to respondents in the empirical research Production Work, 60% of those polled said that humans will continue to be importatat to future production. 36,8% of respondents gave human employees another essential importance. (Gabriel & Pessl, 2016)

Overall, there is an increase in the production volume which is good for manufacturing. As the data is being shared between employees and managers, there is a slight involvement of cybercriminals. The most relevant problem among the companies is technological issues. 90% of the owners say so. There are various steps which can be taken to reduce this and one of the solutions is effective use of communication and collaboration.

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